SELF ALIGNING TRAY AND CARRIER APPARATUS

BACKGROUND OF THE INVENTION

RELATED APPLICATIONS

This application is related to U.S. Application entitled "Standard Tray Carrier For Aligning Trays" filed on the same date as this application, bearing attorney reference 067810/0300803, which is expressly incorporated by reference herein.

FIELD OF THE INVENTION

[0001] This invention relates to trays for use in carrying components such as semiconductor devices, and more particularly to a carrier tray and component tray combination configured to self-align component trays in a carrier tray so as to assure accurate component pocket locations.

DESCRIPTION OF THE RELATED ART

[0002] Semiconductor devices such as integrated circuits (ICs) are typically conveyed in component pockets in trays prior to being installed in a final product. ICs may be placed in and removed from a tray by means of automated IC handling equipment. Calibration of such equipment requires knowledge of the dimensions of the tray and relative positions of the component pockets in the tray. In order to aid in the design and use of this automated equipment, standard tray sizes have been established for some applications. One such set of standards is the Joint Electron Device Engineering Council (JEDEC) standards, which set tray outline dimensions.

[0003] A commonly used JEDEC standard tray for example, has overall dimensions of 322.6 mm by 135.9 mm by 7.62 mm. This large size tray could contain a large quantity of component pockets. It is often desirable to use smaller trays for carrying smaller quantities of

components, but the smaller trays may have dimensions that are in conflict with a JEDEC standard to which an automated handling machine is calibrated. For example, Fig. 1 shows a 2" x 2" tray. In order to accommodate the smaller tray sizes and at the same time accommodate a JEDEC standard, U.S. Patent Serial No. 6,082,547 by Nentl et al. discloses a "jig" tray with external, overall dimensions of a JEDEC standard, with three openings for inserting three smaller component trays. Spring apparatus is used to force the smaller trays into known positions in the X-Y plane relative to the jig outline. This design has the disadvantage of not providing for secure vertical (Z-direction) captivation, and does not address inter-tray dimensioning.

[0004] A typical prior art bare die component tray 10 with a plurality of component pockets 11 is shown in Fig. 1, and a typical jig tray/carrier tray 12 with carrier tray pockets 13 for holding component trays such as tray 10 of Fig. 1 is shown in Fig. 2. The tolerances on the carrier tray pockets 13 and the overall dimensions of the component trays 10 (Fig. 1) are such as to allow adequate clearance and low component tray and carrier tray production cost. The result is that the position of a component tray and resulting position of a component tray pocket when the component tray is in a carrier tray pocket, is not known accurately enough to allow calibration of handling equipment for precision locating of a component tray pocket.

SUMMARY

[0005] It is an advantage of this invention to provide a component tray and carrier tray apparatus with facility for a plurality of component trays, that provides precision location of component tray pockets.

[0006] It is another advantage of this invention to provide a component tray and carrier tray apparatus that positions a plurality of component trays so as to make the center-to-center distance between all component tray pockets an integer multiple of a given center-to-center component tray pocket spacing.

[0007] It is another advantage of this invention to provide a combination component tray and carrier tray apparatus that positions a plurality of component trays so as to facilitate precision calibration of tray handling equipment.

[0008] In one embodiment of the present invention, a carrier tray has a plurality of rectangular shaped carrier tray pockets, each pocket for holding a corresponding component tray. Two adjacent first sides of each carrier tray pocket include reference surfaces for accurately positioning two sides of a component tray that is positioned in the carrier tray pocket. Two adjacent second sides of each carrier pocket each include at least one protrusion from each side, the protrusions for compressing resilient members on sides of a component tray that is inserted in the carrier tray pocket, wherein the resilient members are for the purpose of urging the component tray against the reference surfaces of the carrier tray pocket.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The above and other features and advantages of the present invention are further described in the detailed description which follows, with reference to the drawings by way of non-limiting exemplary embodiments of the present invention, wherein like reference numerals represent similar parts of the present invention throughout several views and wherein:

[00010] Fig. 1 illustrates a prior art 2" x 2" component tray;

[00011] Fig. 2 is a perspective view of a prior art carrier tray apparatus;

[00012] Fig. 3 illustrates a carrier tray and component tray combination apparatus according to the present invention;

[00013] Fig. 4 is an enlarged sectional view for description of the operation of the apparatus of Fig. 3.

[00014]

Fig. 5 is a planar view showing component trays installed in a carrier tray;

[00015] Fig. 6 is a perspective view showing a component tray installed in a carrier tray;

[00016] Fig. 7 is an enlarged sectional view of a component tray installed in a carrier tray;

[00017] Fig. 8 is a cross sectional view of a component tray showing a slot through the component tray edge/perimeter area forming a spring;

[00018] Fig. 9 shows an alternate embodiment of a flat spring attached to a component tray; and

[00019] Fig. 10 illustrates accurate, known spacing between component tray pockets, and between carrier tray edges and component tray pockets according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[00020] While the present invention will be described herein with reference to particular embodiments thereof, a latitude of modifications, various changes and substitutions are intended, and it will be appreciated that in some instances some features of the invention will be employed without a corresponding use of other features without departing from the spirit and scope of the invention as described with respect to the preferred embodiments set forth herein.

[00021] Referring now to Fig. 3, one embodiment of the present invention includes a carrier tray 14 having dimensions L, W and D, any one or more of which may in an alternate embodiment conform to a JEDEC standard. Within the dimensions L, W and D, the carrier tray 14 includes a plurality of carrier tray pockets 16. Although ten pockets 16 are shown in Fig. 3, the present invention includes any quantity. Each pocket 16 has a bottom structure 18 providing vertical support upon which a component tray, illustrated by tray 20, can be placed. The bottom structure 18 can be flat plane as shown, or any other configuration for supporting a component tray. For example, a plurality of rails could provide support. Each pocket 16 also has lateral containment apparatus, shown as four sidewalls 22-28. Two adjacent side walls, illustrated in Fig. 3 as sides 22 and 24 are configured with reference surfaces 23 and 25, respectively, protruding outward from recessed surfaces 27 and 29 to provide accurate dimensional reference surfaces for contact with corresponding two sides 30 and 32 of a component tray 20.

[00022] Referring now to Fig. 4, the combination of a carrier tray 14 and a component tray 20 is shown, wherein the combination is configured to urge the component tray 20 against walls 22 and 24 upon installation of the component tray in the pocket 16. In order to accomplish this, each component tray 20 has flexible resilient members 36 and 38 on adjacent sides 40 and 42. Each pocket 16 of the carrier tray 14 has two adjacent walls 26 and 28, opposite to walls 22 and 24, configured with at least one protrusion 44 and 46, respectively. The dimension d_1 from wall reference surface 24 to protrusion 46 is designed to be less than the dimension A of the component tray 20 so as to cause the protrusion 46 to compress the resilient member 38 upon installation of a

component tray 20 in a carrier tray pocket 16, and thereby force the side 32 of component tray 20 against reference surfaces 25. Similarly, the distance d_2 from reference surface 23 to protrusion 44 is designed to be less than the distance B of component tray 20 for forcing the side 30 of component tray 20 against reference surface 23 of the carrier tray pocket 16.

[00023] Fig. 5 shows a planar view of a component tray 20 in place in a pocket 16 of a carrier tray 14, and Fig. 6 is a perspective view of part of the carrier tray 14, with a component tray 20 installed.

[00024] Fig. 7 is an enlarged sectional view "C" taken from Fig. 5, and more clearly shows the reference surfaces 23 and 25 of the two walls 22 and 24. Fig. 7 also shows the resilient members 36 and 38 compressed by protrusions 44 and 46, respectively. The construction of the resilient members 36 and 38, more clearly apparent from the enlarged view of Fig. 7, is accomplished by simply forming the elongated slots 48 and 50 that extend through the component tray 20 edge portions 52 and 54. The cross sectional view D-D of Fig. 8, referenced in Fig. 4, shows slot 50 extending through the edge portion 54 of component tray 20. With the resilient members 36 and 38 formed as an integral part of the component tray 20 as shown, the component tray material must be of a type with adequate flexibility and resilience characteristics for an adequate spring effect. Selection of such a material and appropriate length, thickness and required deflection, and the corresponding height "h" of the protrusion will be apparent to those skilled in the art without undue experimentation. Example materials include polycarbonate, polypropylene and ABS, all with or without carbon powder loading. A typical resilient member 36 and 38 may have dimensions including a length of .75 inches, a thickness of .05 inches, and a height of .09 inches.

[00025] An alternative embodiment of the present invention is illustrated in Fig. 10 wherein a carrier tray 64 is shown holding component trays 20. The carrier tray 64 has carrier tray pockets 66 with sides having reference surfaces as described in reference to carrier tray 14 of Fig. 3, etc. Each pocket 66 in the carrier tray 64 also has the two protrusions, and each component tray 20 has the resilient members, the combination of carrier tray and component trays thereby accurately positioning each component tray in each corresponding carrier tray pocket. Up to this point in the description of Fig. 10, the carrier tray is similar to the one described in reference to Fig. 3. According to the alternate embodiment of Fig. 10, the carrier tray 64 inter-pocket walls 68, i.e., all

the walls separating the component trays 20 one from another, have thicknesses (w_1 and w_2) dimensioned so that for a given component tray 20, the distances I_1 and I_2 are each an integer multiple of the center to center spacing S_1 of adjacent component tray pockets 70. The accurate spacing between component tray pockets is a benefit when automated equipment is employed to place and pick-up components from the component tray pockets.

[00026] As a still further alternate embodiment, the distances S_2 and S_3 from the carrier tray sides 72 and 74 to the component tray pockets 70 are also dimensioned to be accurate, known distances allowing precision calibration of automated equipment.

[00027] Further alternative constructions of the present invention will be apparent to those skilled in the art upon reading the present disclosure. For example, referring again to Figs. 3 and 4, two reference surfaces indicated as item numbers 23 and two as 25 per component tray pocket are shown. Alternatively, the two surfaces 23 on a side can be joined so as to extend the majority of the length of the wall. Cut-outs at each corner could be provided in order to avoid any interference to the reference surface 23 due to a corner radius, or as a further alternative, instead of a cut-out in each corner, each corner of the component tray could be mitered.

[00028] Although the carrier tray pockets 16 of Figs. 3 and 4 are all shown to be the same size, for the same size component trays, the carrier tray pockets could be of different sizes for carrying different size component trays.

[00029] The carrier tray 14 of Figs. 3 and 4, and carrier tray 64 of Fig. 10 are shown as having enclosed carrier tray pockets 16 and 66. Alternatively, instead of having enclosed pockets 16 and 66 i.e. with four walls, the pocket formed by walls 22-28 (Fig. 4) could be functionally replaced by placing pins protruding from the carrier tray base. For example, two pins could provide proper support in reference to a component tray wall, and a pin could be positioned to serve as a compressive protrusion 44 for example, with no other pin required for that side of the "pocket".

[00030] The present invention also includes other resilient member configurations attached to or integral with the component tray 20 that will be apparent to those skilled in the art upon reading the present disclosure. For example, a separately constructed flat or curved elongated resilient element can be attached to a component tray similar to component tray 20. For example, Fig. 9 shows an alternate embodiment 56 with an elongated resilient member 58 held in place by pockets

60 and 62 formed in the component tray. The spring in this case can be any of various resilient and flexible materials as will be understood by those skilled in the art.

[00031] As a still further alternate embodiment, in reference for example to Fig. 4, the two elongated resilient members 36 and 38 on the component tray 20 and corresponding protrusions 44 and 46 on the carrier tray 14 can be replaced in function by a single resilient member on the corner joining walls 40 and 42 of a component tray. In this case the resilient member could be for example a coil spring attached to the component tray corner and acting against an appropriately mating surface in the corresponding corner of the carrier tray pocket.

[00032] Installation and removal of a component tray from a carrier tray pocket can be accomplished in a number of ways that will be apparent to those skilled in the art. Referring to Fig. 4, one method of installation uses a thin bladed gripping tool with one or more first blades for contacting side 32 in the area which will correspond to the recesses 29 upon installation of the component tray in the pocket, and one or more second blades gripping the side 42 in the area or areas which correspond to either or both sides of the protrusion 46. Similarly, blades contact the component tray on ends 30 and 36. The pressure of the gripping tool is used to compress the resilient members 36 and 38 so as to clear the protrusions 44 and 46 upon installation, and to relieve the pressure for removal of the component tray.

[00033] While the present invention has been described herein with reference to particular embodiments thereof, a latitude of modifications, various changes and substitutions are intended in the foregoing disclosure, and it will be appreciated that in some instances some features of the invention will be employed without a corresponding use of other features without departing from the spirit and scope of the invention as set forth in the appended claims.